

REVISIT ANALYSIS OF MICROSATELLITE CONSTELLATION

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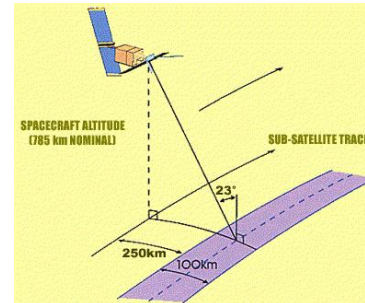
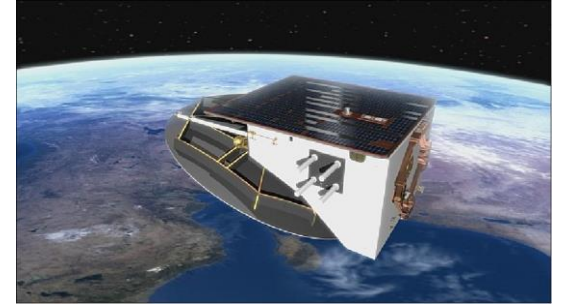
19 October 2016

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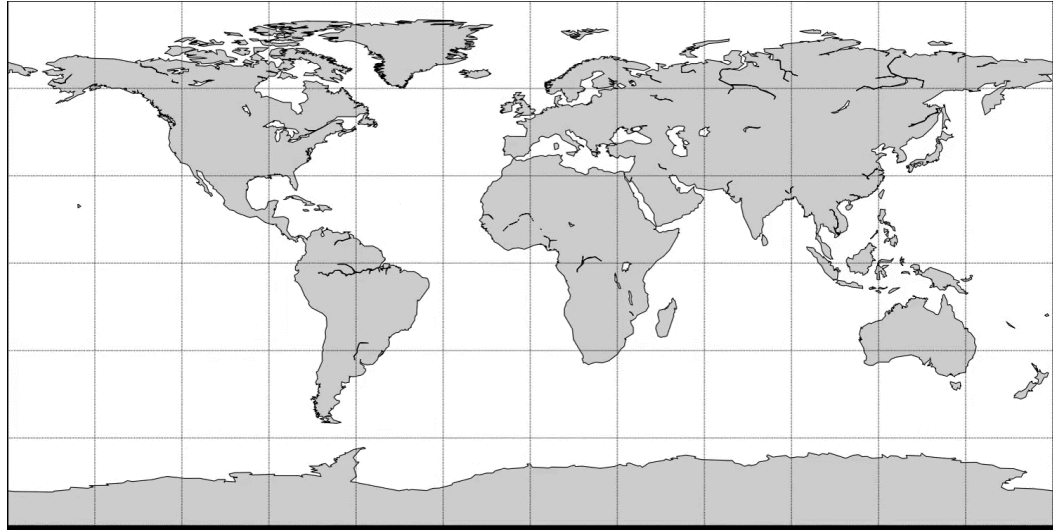
INTRODUCTION

- ▶ SARGUS Project : Synthetic Aperture Radar Payload Simulation
 - ▶ Model radar hardware
 - ▶ Raw data from signals
 - ▶ Image from raw data
 - ▶ Mission planning
 - ▶ Concept design



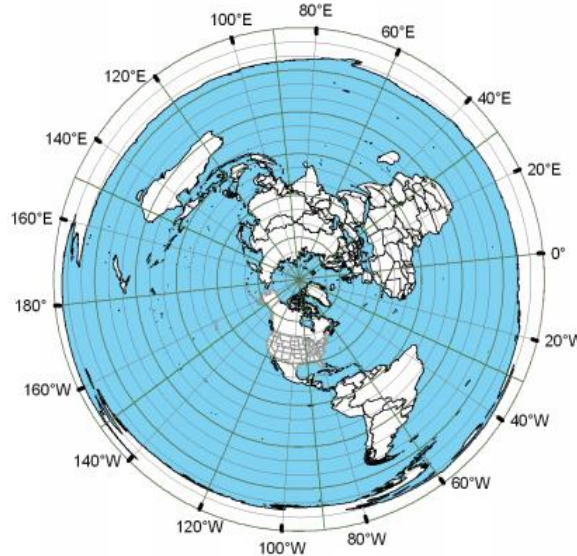
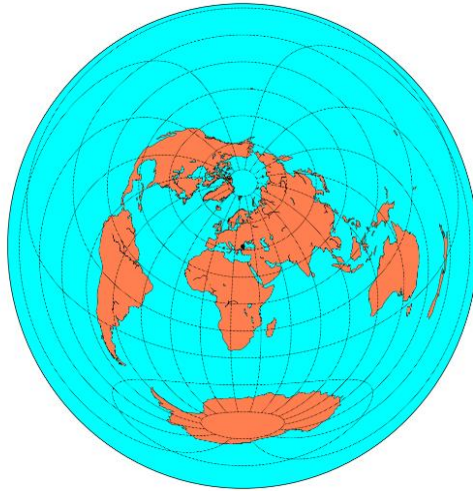
Orbit Propagator

- ▶ 2 Body Propagator & RK4 Solver
- ▶ SGP4 1.4– Python Package



Potential Swath Determination

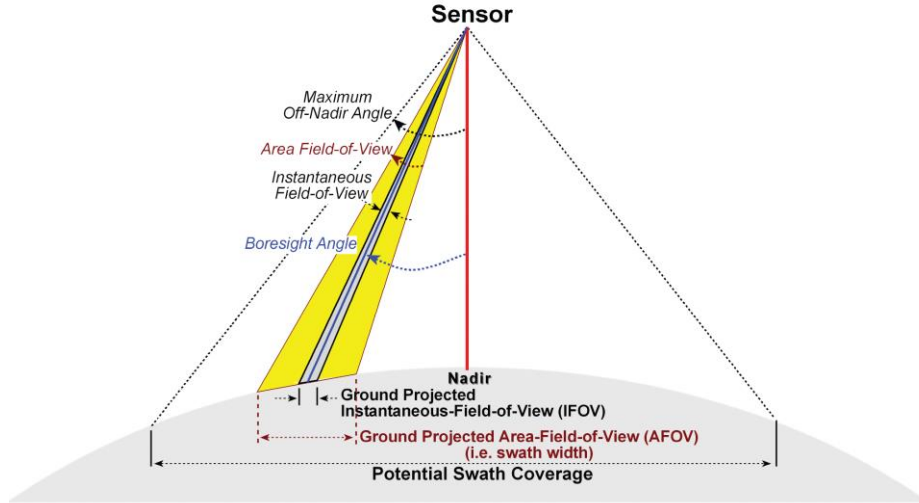
► Azimuthal Equidistant Map Projection



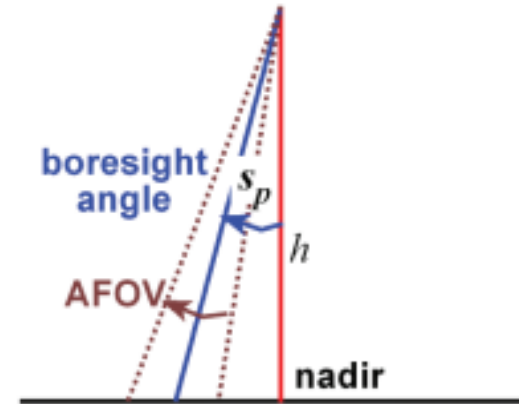
- Offered by «Hodgson and Kar»
- Distances measured from the center are true
- Directions from the center are true.

Potential Swath Determination

- Potential Swath :: off-nadir angle
- Planar Assumption

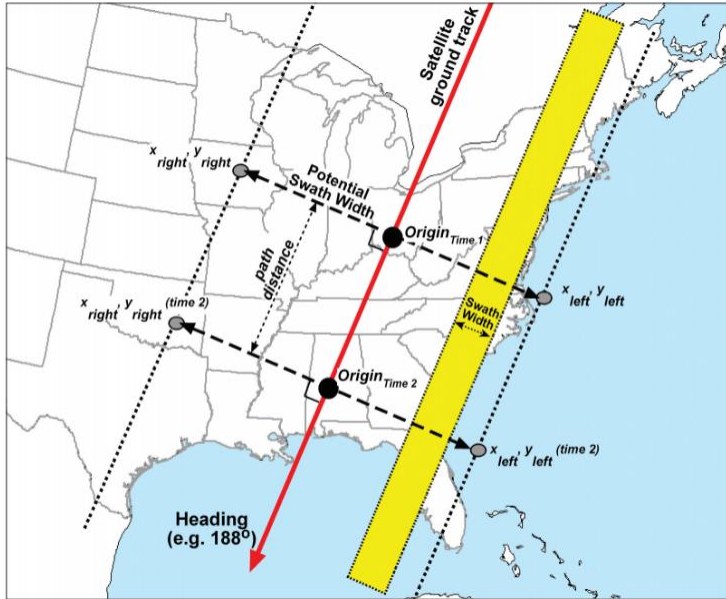


Planar Assumption (Right triangle solution)



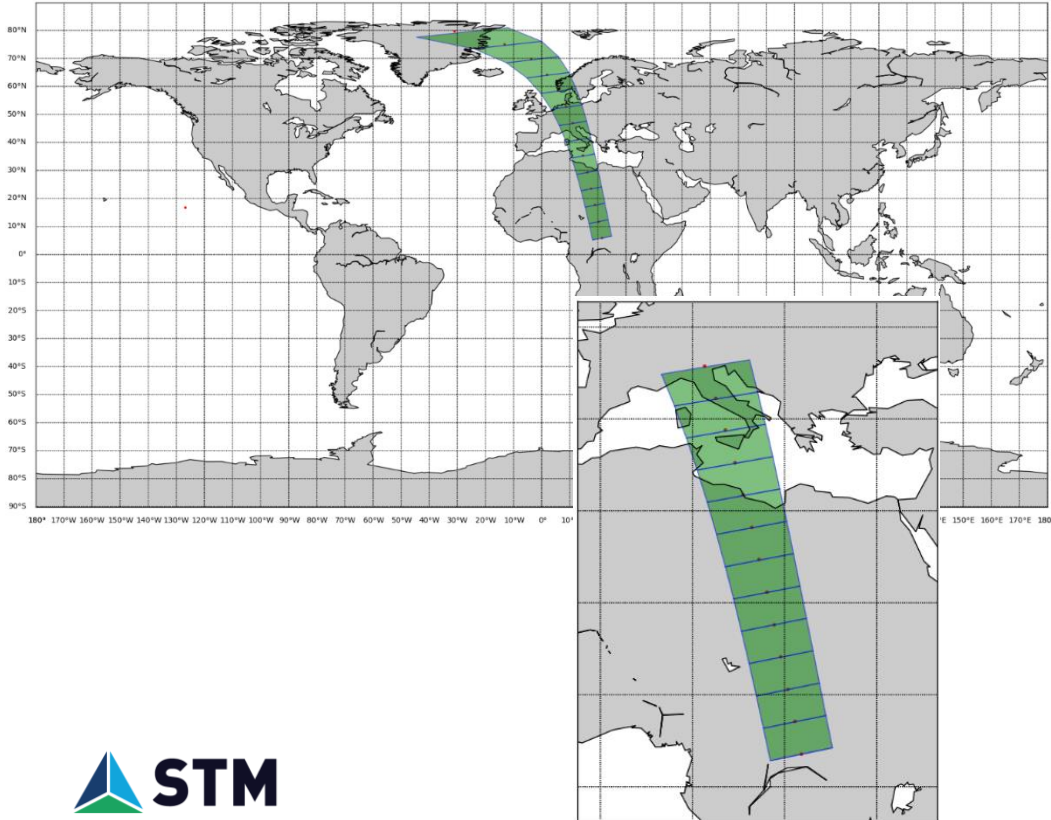
Hodgson, M. E., & Kar, B. (2008).

Potential Swath Determination



1. Collect satellite viewing geometry (off-nadir angle)
2. Model the position of satellite @ $t_1, t_2, \dots$
3. Determine potential visible swath through times $t_1, t_2,$

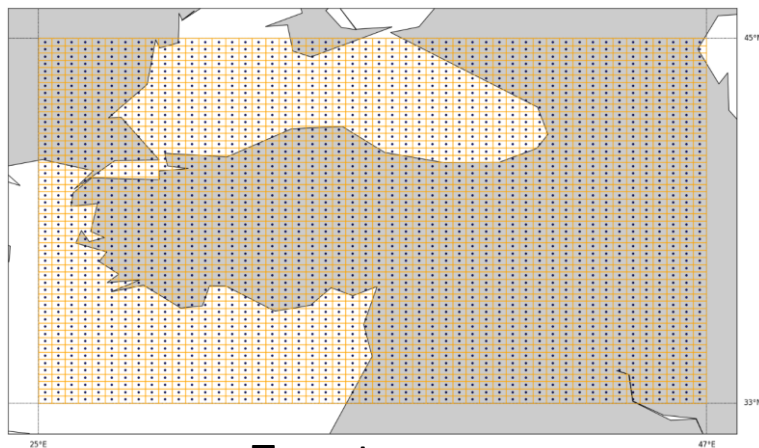
Potential Swath Determination



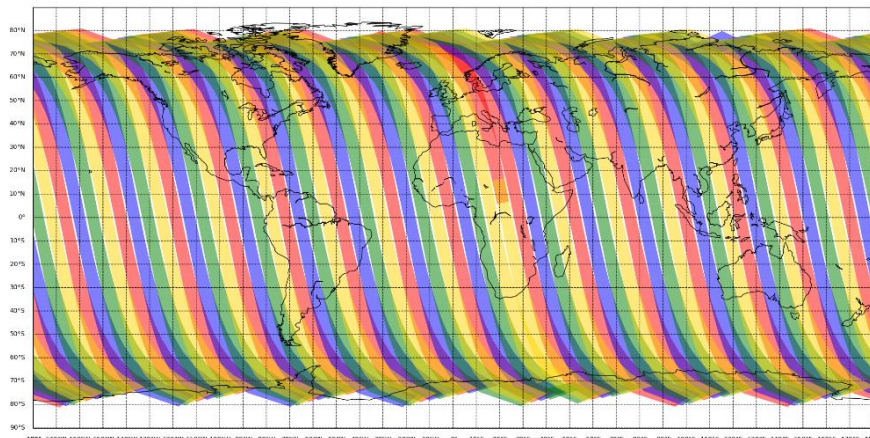
4. Integrate all potential swaths to form a potential swath coverage
5. Map the potential swath coverage with appropriate GIS context

Coverage Analysis

- ▶ Target Area Creation
- ▶ Potential Swath Polygon Creation
- ▶ Mapping SW polygon on target area



Target area



Potential swath polygon

MISSION STATEMENT

Mission	Mapping, urban planning, research of forest vegetation and agricultural lands, disaster monitoring etc.
Coverage	25°- 47° E & 34°- 43° N (Turkey and near region) Daily access
Daily Image Count	Continuous imaging during a pass within Turkey region
Image Specifications	PAN: 1.5 m GSD MS: 5-6 m GSD
Swath Width	Min 10 km x 10 km (Nadir direction)
Satellite Size	Has to have proper size in line with microsatellite & constellation concept
Reliability	>%95 in lifetime

- ▶ Main assumption: Electro-Optic Payload with 1.5m GSD @ 550 km SSO
- ▶ Main requirement: Daily access for Turkey region

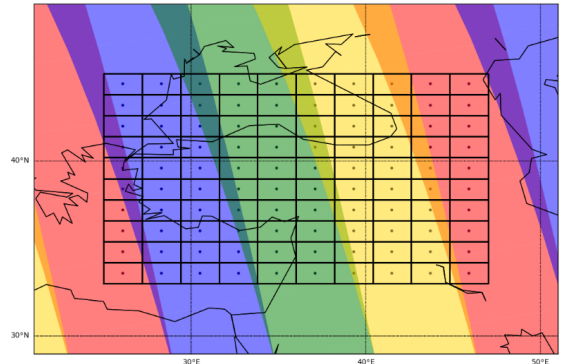
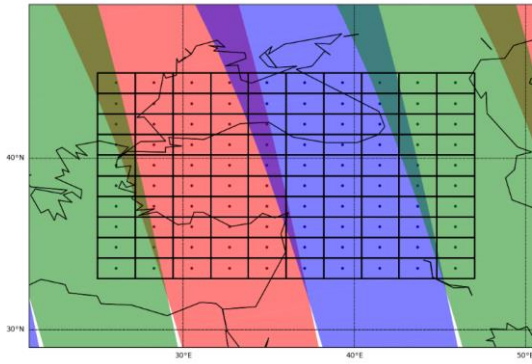
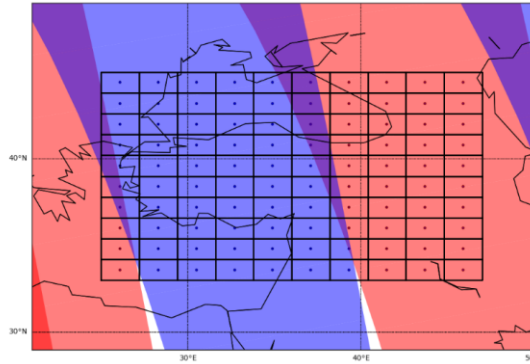
Constellation Configuration

Potential Swath Width required for
Daily Access

$$V_{@33 \text{ North}} \approx 389 \text{ m/s}$$

$$L_{@97 \text{ min}} \approx 2281 \text{ km}$$

# Sat	Req. Projection of swath at latitude 33 N (km)	Minimum Pot. Half Swath Width (km)
1	2281	1149
2	1140	575
3	760	383
4	570	287
5	456	230
6	380	192



Constellation Configuration

Swath width values according to altitude and off-nadir angle

	Half Swath Width (km)			
Altitude (km)	25° ona	30° ona	32,5° ona	35° ona
400	187	231	255	280
450	210	260	287	315
500	233	289	319	350
550	256	318	350	385
600	280	346	382	420
650	303	375	414	455
700	326	404	446	490
750	350	433	478	525
800	373	462	510	560

Constellation Configuration

Some constellation configurations with daily access ability

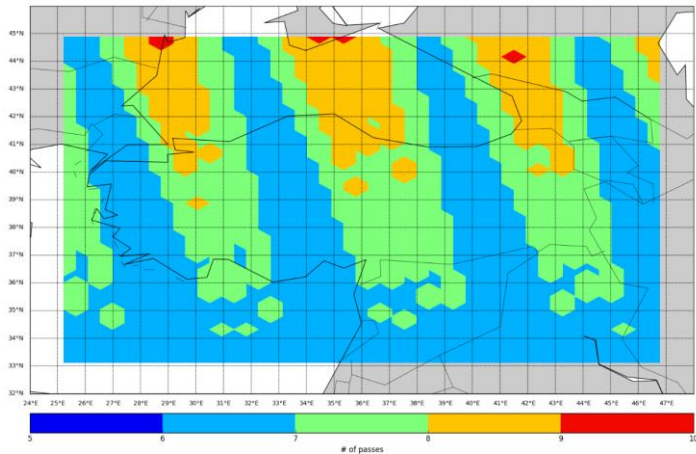
	# of Satellite	Altitude (km)	LTAN	Off-Nadir Angle (°)
Cons. 1	2	820	10:30 AM	35
Cons. 2	3	658	10:30 AM	30
Cons. 3	3	597	10:30 AM	32.5
Cons. 4	3	543	10:30 AM	35
Cons. 5	4	494	10:30 AM	30
Cons. 6	4	448	10:30 AM	32.5
Cons. 7	4	407	10:30 AM	35
Cons. 8	4	820	10:30 AM, 15:30 AM	35

Imaging performance

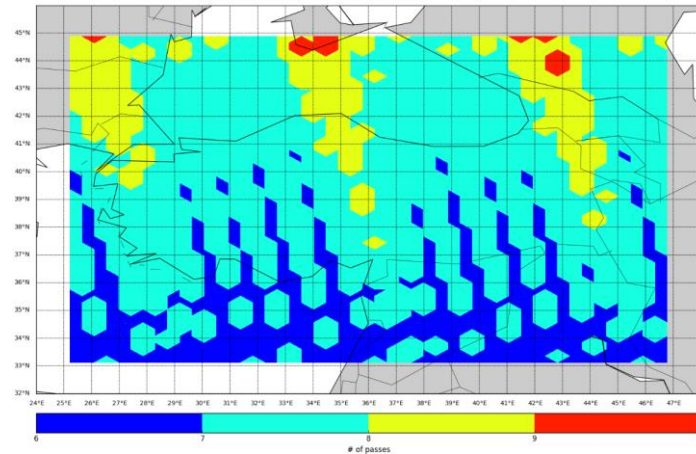
Altitude (km)	ONA (°)	Expected GSD @ nadir (m)	Expected GSD @ boundary (m)
820	35	2.22	2.71
658	30	1.79	2.07
597	32.5	1.63	1.93
543	35	1.48	1.81
494	30	1.35	1.56
448	32.5	1.22	1.45
407	35	1.11	1.36

Results - # of passes (7 days)

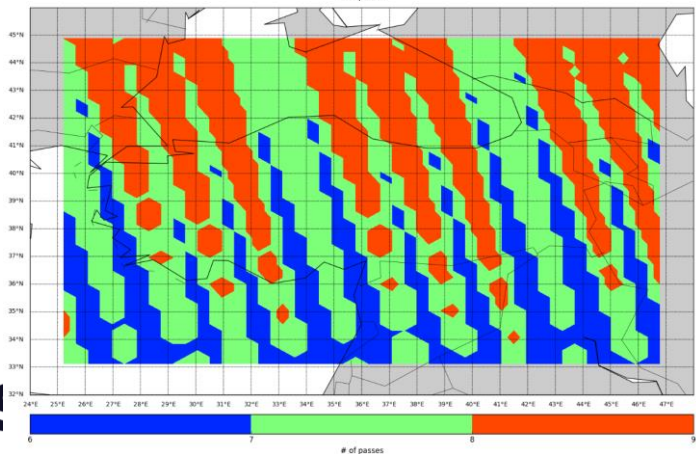
Cons. 1



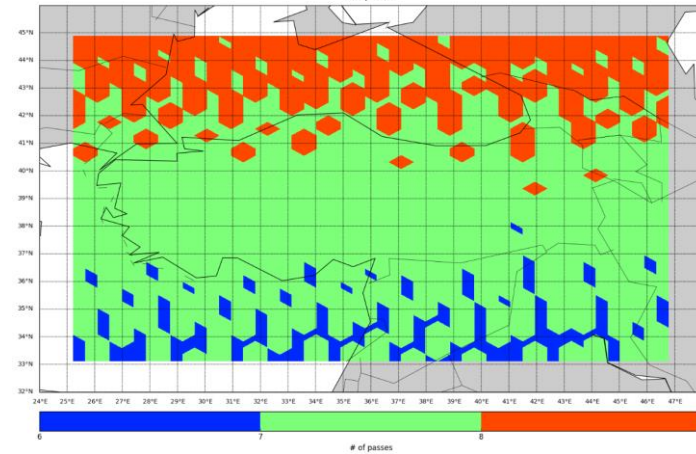
Cons. 2



Cons. 3

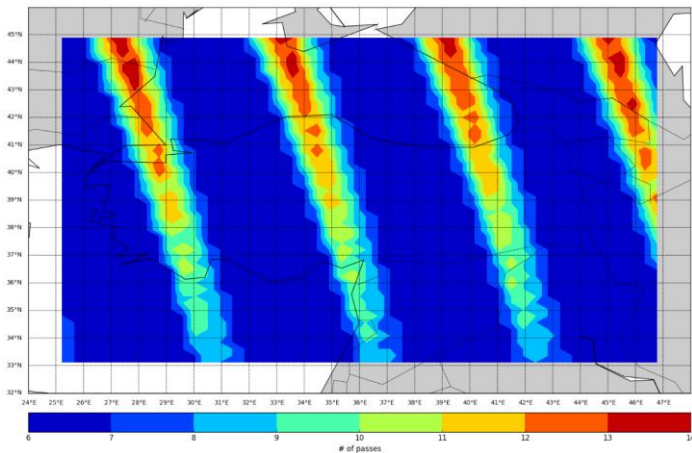


Cons. 4

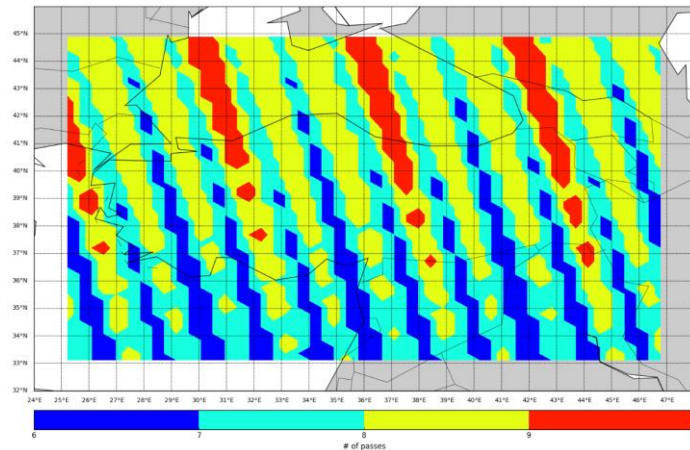


Results - # of passes (7 days)

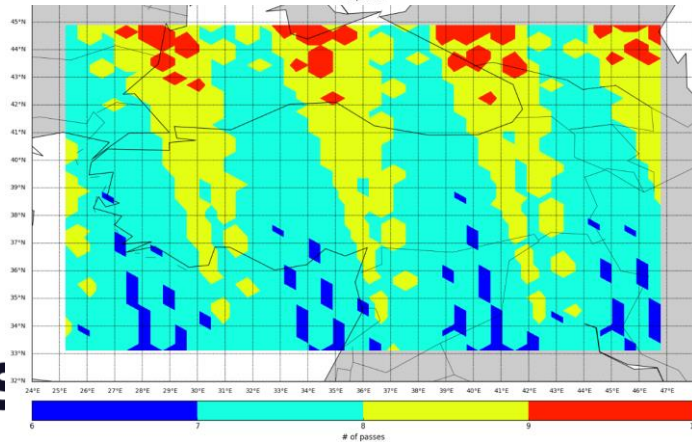
Cons. 5



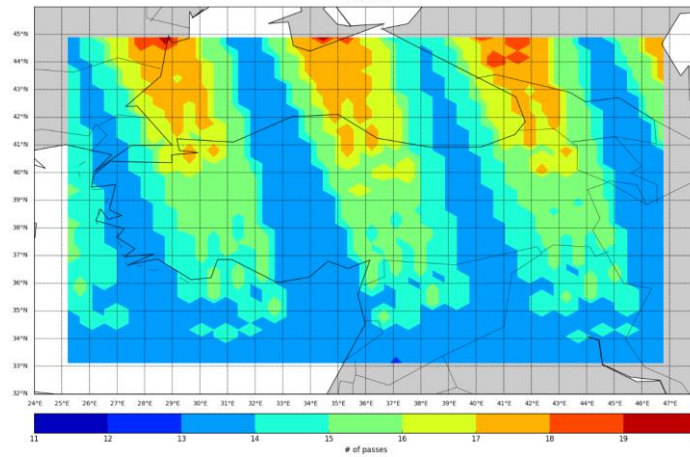
Cons. 6



Cons. 7

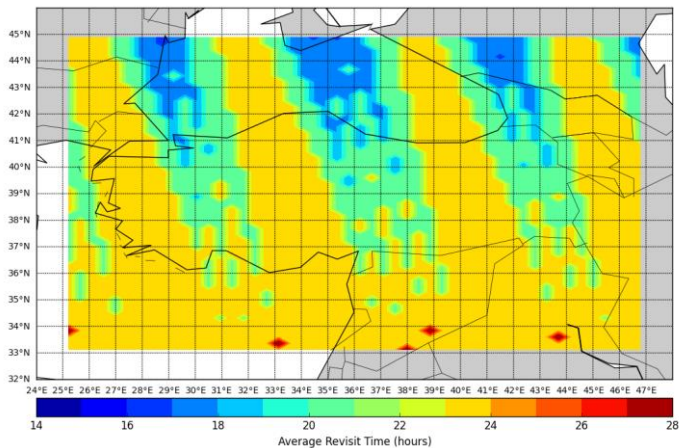


Cons. 8

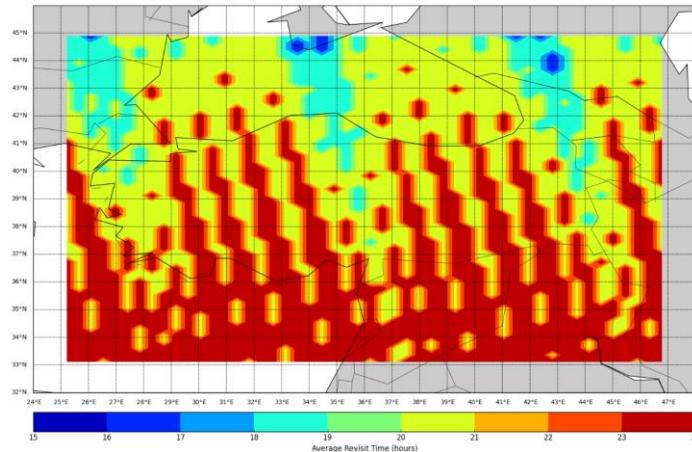


Results – Average Revisit Time (hours)

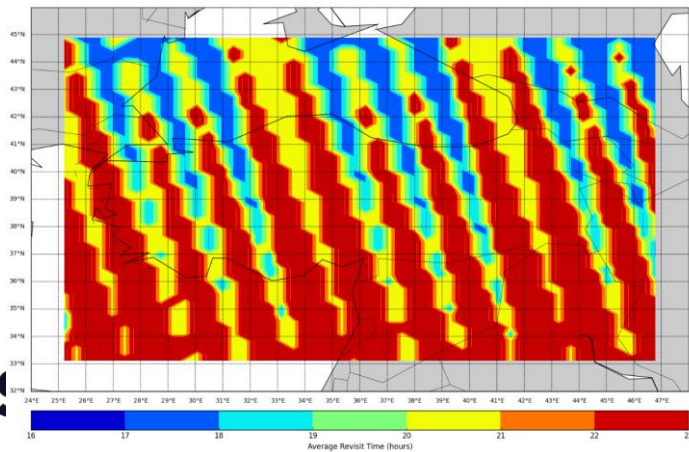
Cons. 1



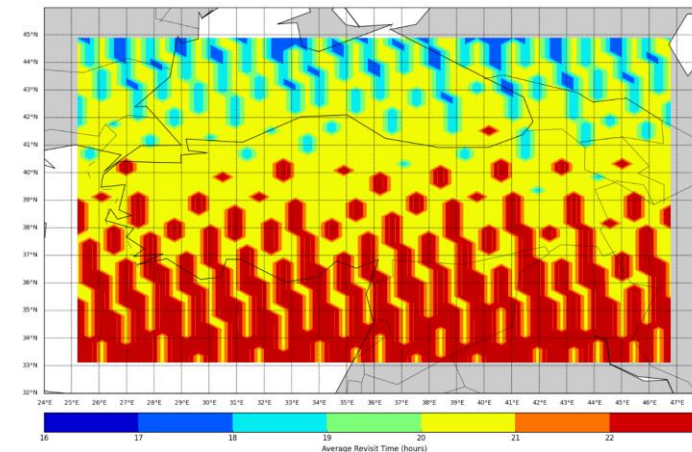
Cons. 2



Cons. 3

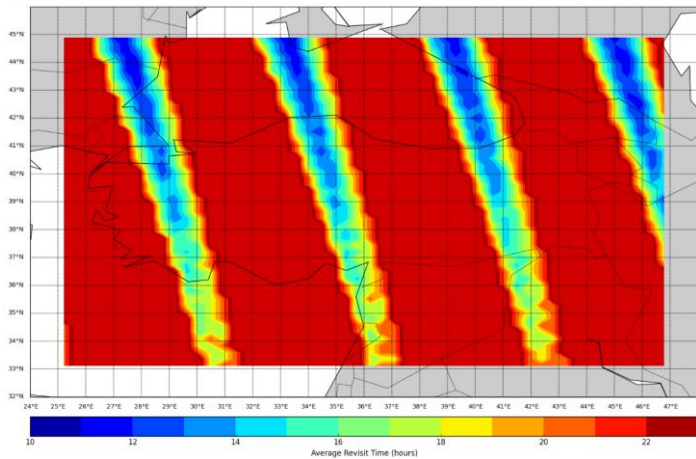


Cons. 4

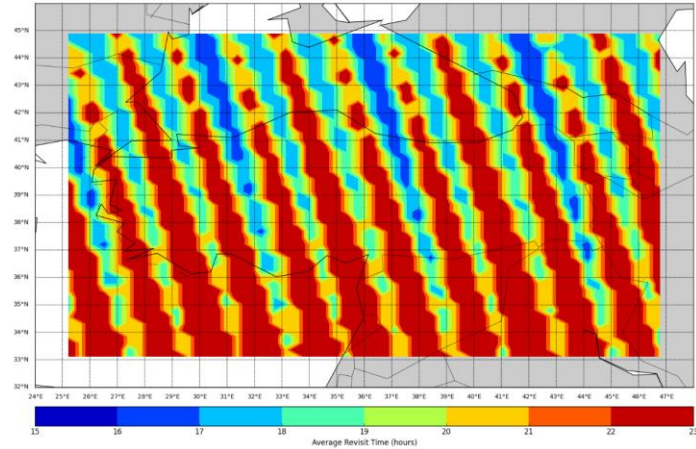


Results – Average Revisit Time (hours)

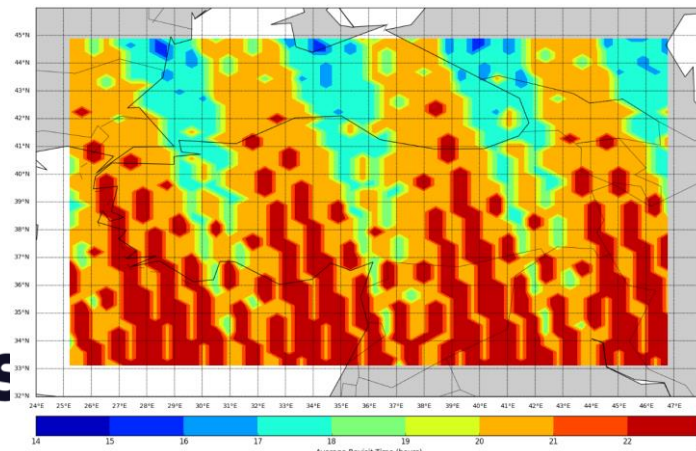
Cons. 5



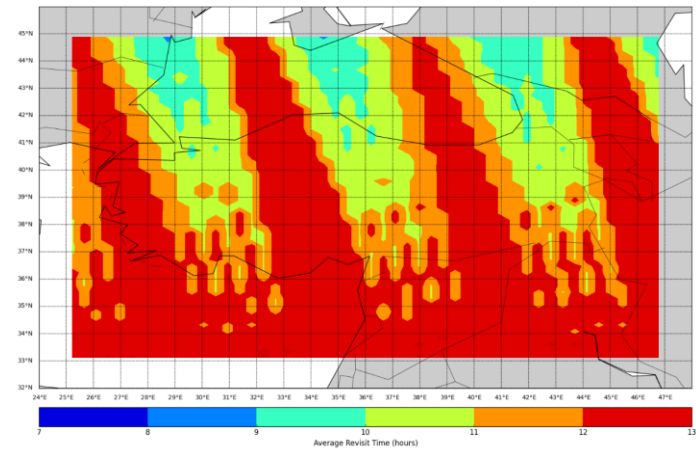
Cons. 6



Cons. 7



Cons. 8



THANK YOU



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